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| 10/566,099 | 05/08/2006 | Tadahiro Ohmi | 039262-0147 | 9568 |

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FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

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| EXAMINER |
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CAMPBELL, NATASHA N.

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1714

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09/07/2010

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--------------------------------------|------------------------------------|--|
| Office Action Summary | Application No. 10/566,099 | Applicant(s) OHMI ET AL. | |
| | Examiner NATASHA CAMPBELL | Art Unit 1714 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 March 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 July 2009 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 03/23/2010 has been entered.
2. Claims 1-16 are currently pending.
3. The rejection of Claims 4-12 under 35 USC 102 have been withdrawn, in view of applicant's amendments.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 1-3 and 14 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Otsuki et al. (US 2002/0005213).

9. Regarding Claim 1: It is noted that Claim 1 is a product-by-process claim. Otsuki discloses a silicon carbide product comprising a polycrystalline silicon carbide that has a surface with a concentration of metal impurities equal or less than 1×10^{11} (atoms/cm²)

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([0012]-[0013]). In the alternative, because of the nature of product-by process claims, the Examiner cannot ordinarily focus on the precise difference between the claimed product and the disclosed product. It is then Applicants' burden to prove that an unobvious difference exists. See *In re Marosi*, 218 USPQ 289, 292-293 (CAFC 1983). Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps (MPEP 2113 [R-1]).

10. Regarding Claim 2: Otsuki further discloses that said metal impurities may be Iron, Nickel or Copper (Page 11, Table 1).

11. Regarding Claim 3: Otsuki further discloses that the silicon carbide product is a semiconductor device [0002].

12. Regarding Claim 14: It is noted that Claim 14 is a product-by-process claim. Otsuki discloses a polycrystalline silicon carbide product that is a semiconductor device [0002]. In the alternative, because of the nature of product-by process claims, the Examiner cannot ordinarily focus on the precise difference between the claimed product and the disclosed product. It is then Applicants' burden to prove that an unobvious difference exists. See *In re Marosi*, 218 USPQ 289, 292-293 (CAFC 1983). Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps (MPEP 2113 [R-1]).

13. Claims 4, 5, 14, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chinone et al. ("Applications of High Purity SiC Prepared by Chemical Vapor Deposition).

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14. Regarding Claim 4: Chinone teaches a silicon carbide product cleaning method comprising subjecting a polycrystalline silicon carbide that is obtained by a CVD method in an acid to clean the product (page 200, sec. 3-1). Although he does not specifically teach immersing the product, one of ordinary skill in the art at the time of the invention would have been motivated to modify the method by immersing the product in order to thoroughly wash the product. Further, although Chinone does not specifically teach that surface metal impurities are reduced to 1×10^{11} atoms/cm² or less, it is held that since the cleaning step is taught by the prior art, and as there are no other positively recited process steps, one of ordinary skill in the art would have reasonably expected to achieve the results as claimed by performing the method of Chinone.

15. Regarding Claim 5: Chinone teaches a method of manufacturing a silicon carbide product composed of polycrystalline silicon carbide that is obtained by a CVD method (page 198, sec. 1), comprising forming the polycrystalline silicon carbide product; and cleaning the silicon carbide only by an acidic solution (page 200, sec. 3-1). Although Chinone does not specifically teach that surface metal impurities are reduced to 1×10^{11} atoms/cm² or less, it is held that since the cleaning step is taught by the prior art, and as there are no other positively recited process steps, one of ordinary skill in the art would have reasonably expected to achieve the results as claimed by performing the method of Chinone.

16. Regarding Claim 14: Chinone teaches a silicon carbide product manufactured by the method of Claim 5 being a semiconductor device, semiconductor device manufacturing member, or a structure (page 198, first paragraph).

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17. Regarding Claim 16: Chinone teaches the elements of Claim 5, as described above. He further teaches forming the SiC polycrystalline layer by providing a base member (graphite), and growing the SiC over the base member (page 198, sec.2).

18. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chinone et al. ("Applications of High Purity SiC Prepared by Chemical Vapor Deposition) as applied to claim 5 above, and further in view of Sibley (US 5,443,649).

19. Regarding Claim 15: Chinone teaches that the step of forming polycrystalline silicon carbide is for preparing the polycrystalline silicon carbide (see page 198, sec. 1), and comprises growing a polycrystalline silicon carbide layer over a graphite base by the CVD method (page 198, sec. 2); removing side portions of the SiC layer (i.e., removing the circumference; sec. 3-1); and burning out the graphite base member to form the silicon carbide product (sec. 3-1). He does not specifically teach forming a pair of polycrystalline silicon carbide layers.

20. However, Sibley teaches a method of forming a SiC product in which SiC is grown over a graphite base, portions of the SiC layer are removed, and then the graphite base is burned away to leave the desired SiC product (col. 4, lines 38-49). The remaining product is a shell of the deposited SiC. Although Sibley does not specifically teach forming a pair of polycrystalline SiC layers, he is cited for teaching the removal of portions of the SiC layer, and burning an interior graphite base to leave only a desired product (i.e., applicant's pair of polycrystalline SiC layers). By this teaching, one of ordinary skill in the art at the time of the invention would have been motivated to modify

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the method of Chinone to grow a SiC layer over a whole of a graphite base, as taught by Sibley, and burn out the graphite base to form a pair of SiC layers, as claimed, in order to maximize the use of the SiC product.

21. Claims 4-6, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake (US 2001/0015170).

22. Regarding Claim 4: Kitabatake teaches a method for cleaning silicon carbide comprising subjecting a single crystal silicon carbide that is obtained by a CVD method [0132] in an acid [0104]. Although he does not specifically teach immersing the product, one of ordinary skill in the art at the time of the invention would have been motivated to modify the method by immersing the product in order to thoroughly wash the product. Further, although Kitabatake does not specifically teach that surface metal impurities are reduced to 1×10^{11} atoms/cm² or less, it is held that since the cleaning step is taught by the prior art, and as there are no other positively recited process steps, one of ordinary skill in the art would have reasonably expected to achieve the results as claimed by performing the method of Kitabatake.

23. Regarding Claim 5: Kitabatake teaches a method of manufacturing a silicon carbide product composed of a single crystal silicon carbide that is obtained by a CVD method (see abstract and [0132]), comprising forming the single crystal silicon carbide ([0117]-[0132]); and cleaning the single crystal silicon carbide only by an acidic solution [0104]. Kitabatake does not specifically teach that surface metal impurities are reduced to 1×10^{11} atoms/cm² or less. However, it is held that since the cleaning step is taught

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by the prior art, and as there are no other positively recited process steps, one of ordinary skill in the art would have reasonably expected to achieve the results as claimed by performing the method of Kitabatake.

24. Regarding Claim 6: Kitabatake further teaches that the acid is hydrofluoric acid [0104].

25. Regarding Claim 16: Kitabatake further teaches that the silicon carbide single crystal comprises providing a base member; and growing the single crystalline SiC over the base member [0138].

26. Claims 7-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake (US 2001/0015170) as applied to Claim 6 above, and further in view of Otsuki et al. (US 2002/0005213).

27. Regarding Claims 7 and 8: Kitabatake teaches the elements of Claim 6, as described above. Kitabatake does not teach the concentrations of HF as claimed. However, these concentrations of HF are known in the art for cleaning SiC products. For example, Otsuki teaches cleaning with HF having a concentration of 0.3% to 68% which includes a concentration exceeding 45% and a concentration of about 50%, as claimed. Otsuki teaches that concentrations within these ranges are effective for removing metal impurities ([0094]-[0095]). Therefore, one of ordinary skill in the art at the time of the invention would have been motivated to modify the method of Kitabatake by cleaning with HF of about 50% or exceeding 45%, as claimed, in order to ensure removal of metal impurities.

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28. Regarding Claims 9 and 10: Kitabatake teaches the elements of Claim 6, as described above. He does not teach that the acid is hydrochloric acid having a concentration of about 35% or more or 36%. However, Otsuki also teaches that SiC products may be cleaned with HCl [0094]. Further, he teaches that the acidic concentration may be between 0.3% and 68%, which overlaps the claimed ranges. He also teaches that HCl is efficient for removing metal impurities [0095]. Also, since Otsuki teaches using either HF or HCL [0094], these acids are considered to be obvious variants of one another, both efficient for removing metal impurities. Therefore, one of ordinary skill in the art at the time of the invention would have been motivated to modify the method of Kitabatake by cleaning the SiC product with HCl in the concentration ranges as claimed in order to remove metal impurities with a reasonable expectation of success.

29. Regarding Claim 11: Kitabatake teaches the elements of Claim 5, as described above. He does not teach that the acid is a liquid containing sulfuric acid and hydrogen peroxide solution. However, Otsuki teaches cleaning the SiC product with such mixture to remove metal impurities ([0094]-[0095]). Since he also teaches cleaning with HF as Kitabatake does, one of ordinary skill would have recognized that the HF and $\text{H}_2\text{SO}_4/\text{H}_2\text{O}_2$ solutions are obvious variants of each other. Therefore, one of ordinary skill in the art at the time of the invention would have been motivated to clean the product with a liquid mixture containing $\text{H}_2\text{SO}_4/\text{H}_2\text{O}_2$ with a reasonable expectation of successfully removing the metal impurities.

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30. Regarding Claim 12: The prior art does not expressly disclose that the liquid containing said sulfuric acid and said hydrogen peroxide solution has a pH of 4 or less. However, pH is a result effective parameter, because it affects the acidity of the cleaning solution, thus affecting the processing. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the method taught by Kitabatake and Otsuki in order to enhance cleaning efficiency.

31. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake (US 2001/0015170) and Otsuki et al. (US 2002/0005213) as applied to Claim 12 above, and further in view of Ohmi et al. (US 6348157).

32. Regarding Claim 13: Kitabatake and Otsuki teach the elements of Claim 12, as described above. Otsuki discloses using sulfuric acid with a concentration of 98% in the cleaning liquid (Page 10, Paragraph [0134]), but does not expressly disclose that the hydrogen peroxide solution has a concentration of about 30% or that the sulfuric acid and hydrogen peroxide are mixed in a volume ratio of 4:1.

33. Ohmi discloses a cleaning solution comprising 97% sulfuric acid and 30% hydrogen peroxide mixed in a volumetric ratio of 4:1 (Col. 8, lines 47-51). Ohmi teaches that this solution is used to clean a silicon substrate (Col. 8, lines 47-51).

34. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method taught by Otsuki to include a 97% sulfuric acid and 30% hydrogen peroxide mixed in a volumetric ratio of 4:1 as taught by Ohmi in order to

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optimize cleaning, as a solution with these properties has been demonstrated to be effective in removing contaminants from a silicon substrate.

Response to Amendment

35. The declaration under 37 CFR 1.132 filed 03/23/2010 is insufficient to overcome the rejection of Claims 1 and 14 based upon 35 USC 102/103 as set forth in the last Office action because: applicant has not persuasively demonstrated that an unobvious difference exists between the claimed product and that of the prior art. Specifically, applicant has performed an experiment in which both applicant's method and the prior art method was used to produce the product. Applicant is relying on the fact that the samples cleaned by the prior art did not ***always*** reduce the surface concentration of impurity to that as claimed. However, upon review of applicants' declaration and results (Table 1), it is noted that the prior art did in fact produce the claimed product at least in one occurrence (see Sample A1, Table 1, row 1). Therefore, applicants' argument that the cleaning method is inferior and does not always produce the claimed product is not persuasive.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NATASHA CAMPBELL whose telephone number is (571)270-7382. The examiner can normally be reached on Monday-Friday; 9 AM-5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Kornakov can be reached on (571) 272-1303. The fax phone

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number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/N. C./

Examiner, Art Unit 1714

03 Sep 2010

/Michael Kornakov/

Supervisory Patent Examiner, Art Unit 1714